tion, the Report emphasises three principles from which few will dissent—the preservation of the autonomy of the Universities, the free interchange of teachers among educational institutions, and a wide choice of benefits for the beneficiaries; but it carefully omits to state, let alone to emphasise, another important principle, viz. that University teachers should have superannuation benefits at least equivalent to those given by the State to other teachers. Why the autonomy of the University should be emphasised in connection with the question of superannuation is a mystery to the plain man. No one suggests that an annual grant from the Treasury of 1,500,000*l.* is going to limit the autonomy of the Universities; but when University teachers ask that the School Teachers (Superannuation) Act should be extended to the Universities at an estimated additional cost of no more than 70,000*l.* or 80,000*l.* per annum, the bogey of loss of autonomy is immediately raised, and one wonders why. Again, it is one thing to enunciate principles; it is another to carry them into practice. It is all very well for the Committee to talk of the free interchange of teachers and to express a pious hope that it will materialise; but the fact is, there exists at the present moment a distinct barrier in the Superannuation Act to the free interchange of teachers, and there is no guarantee that this barrier will be removed. Further, while the sympathetic attitude of the Chancellor of the Exchequer to the senior members of the staffs who are precluded from profiting by the full benefits of the federated superannuation system is commendable, it is important to note that the capital sum necessary to meet these grievances would amount to something like one and a half millions. Unless we are greatly mistaken, Mr. Chamberlain has no intention of asking the Government for any such amount. The sum of half a million has been suggested, which means that only about a third of retrospective benefits will accrue to those in the federated system. Under the Teachers Act full benefits would accrue. Such distinctions as these do not conduce to harmony, and University teachers cannot be expected to remain content under them.

One or two other points may be noticed. The observations on the tenure and status of teachers, on equipment and accommodation, and particularly those on libraries and special national needs, are interesting and informative, but the suggestion that the three University colleges—Reading, Nottingham, and Southampton—should each look out for a patron University under the ægis of which they might continue their present activities is not alluring. We dislike the principle of a patron University appointing representatives to approve courses and curricula and nominating external examiners. It smacks too much of educational bureaucracy. Why should not these three colleges together constitute a new University and work out their own destinies? In course of time, when the financial position became easier, no doubt they would hive off from one another as full-fledged Universities.

In a paragraph on finance the Report gives some important facts and figures. In his letter of July 16, 1920, Mr. Chamberlain states that, subject to the overriding necessities of national finance, he will submit to Parliament an increase in the vote from one million to one and a half millions in the estimate for 1921–22. While this will make an appreciable difference, it will not meet the needs of the present; other sources will have to be drawn upon. It would be unwise to expect much from a greater increase of fees—already the fees are two or three times greater than they are in America. Apparently little can be expected from private benefactions. There remains, therefore, the local authorities. The principle of a uniform 1*d.* rate throughout the country for University education is sound, but the allocation of the various areas to their respective Universities would be difficult. All the same, looking to the future, the Government might reasonably ask the University Grants Committee to prepare a scheme of areas for the purpose of a possible rate of this kind. If such a scheme of rate aid were adopted, it would naturally form a new basis for estimating the Treasury contribution in the future.

Meteorological Physics.

Physics of the Air. By Prof. W. J. Humphreys. Pp. xi+665. (Philadelphia: J. B. Lippincott Co., 1920.) 5 dollars.

STUDENTS of the science of the atmosphere have read with interest and appreciation the articles by Prof. W. J. Humphreys, of the Weather Bureau of the United States, on various aspects of the physics of the atmosphere which appeared from time to time in the Journal of the Franklin Institute of Philadelphia during the years 1917–20. The reproduction of these articles, revised and collected into a book for publication by the institute, is a notable and welcome event in the history of the study of the air.

Prof. Humphreys is known to us all as an accomplished physicist who is not averse from mathematical reasoning, with a wide range of knowledge; a cautious and rigorous thinker, a competent critic, a clear writer, and a shrewd observer who is well acquainted with the inherent difficulty of associating the unconditioned or uncontrolled phenomena of the atmosphere with the carefully conditioned and completely controlled experiments of the physical laboratory. He is, perhaps, best known to us as having been the first to offer an explanation on a deductive basis of the separation of the atmosphere into troposphere and stratosphere, which appeared almost at the same time as Col. Gold's memoir in the Proceedings of the Royal Society, and as having constructed a very useful diagram of the chemical composition of the atmosphere at different heights, also arrived at deductively, which is reproduced in Prof. Willis Moore's "Descriptive Meteorology" and in the work now under review. It is none the less interesting because Dr. Chapman and Mr. Milne have suggested to the Royal Meteorological Society that the hydrogen which occupies so large a part of the diagram should be left out.

The results of the assiduous study of the phenomena of the atmosphere from the point of view which is characterised by the two examples just given cannot fail to be of interest and importance for meteorology and meteorologists. They range over an extraordinarily wide field. The mechanics and thermodynamics of the atmosphere, including the average meteorological conditions of the surface and the upper air, the physical aspects of their changes, the composition of the atmosphere, insolation and radiation, atmospheric circulation, evaporation and condensation, rain and raindrops, fogs, clouds, thunderstorms and lightning, form only the first part. It includes a very good chapter on winds adverse to aviation. The second part is devoted to atmospheric electricity and auroras, and the third to atmospheric optics, a very acceptable section in view of our lack of a summary of the subject in English books. The fourth deals with factors of climatic control, and comprises a penetrating discussion of the principal theories of glacial epochs, with a remarkably novel and effective discussion of the possible or probable effects of vulcanism.

The book is fully illustrated with many excellent diagrams and photographs excellently reproduced. The pictures of the succession of recorded volcanic eruptions are quite fascinating. Prof. Humphreys may be congratulated on having received from the Franklin Institute such effective assistance in that important side of the presentation of a subject which is largely dependent upon the success of its illustrations.

Apart from the general excellence of the book and the presentation of its material, the parts which impress one most on reading them for the first time are the chapters on thunderstorms and lightning, atmospheric electricity and auroras, and atmospheric optics, as examples of close physical reasoning, and the chapters on factors of climatic control as an example of reasoning of a more general character.

Where there is such a wealth of subject details can scarcely be regarded, but one or two points attract attention. There is nothing in the index under the letter "U," and the reader is left to draw his own conclusions about the units of the physics of the air, which, in the author's country as in ours, involve a question of real importance to progress in science. It must be remembered that the study of the atmosphere appeals not only to students in physical laboratories where intricate questions about units are all in the day's work, but also to persons outside who care little or nothing for the co-ordination of the various parts of the subject, and to whom any references in unfamiliar units are an unmitigated bore. Such questions should, therefore, be treated in a manner that leaves no room for uncertainty. On p. 30, in a discussion of temperature changes under variations of pressure, Prof. Humphreys tosses $g=981$ into a mixture of p's and T's with scarcely any warning to his readers, but on p. 33 he makes use of $\mathrm{D}b$ as the equivalent of pressure p where D is the density of mercury and b the barometric height in millimetres! The explanation of that cryptic equation affords quite a good exercise for the student of physics, but it is not the same as $g=981$. It is not quite fair to his readers to subject their intelligence to this kind of gymnastic, and when physical reasoning has to be addressed to unprofessional, as well as to professional, physicists there is really no alternative but to have a coherent and consistent system of units and to stick to it. The longer the step is postponed, the worse for us. One offence against the life-long habits of a reader may be condoned if it is sufficiently pressed, but no one can expect pardon for two such within three pages of the same book.

On p. 43 the author expresses his preference for "isothermal region" as against "stratosphere" as a name for that part of the atmosphere of which the characteristic feature is that there is no change of temperature with height. This is really astonishing, because to regard the "isothermal region" as really isothermal would be destructive of the whole plan of the structure of the atmosphere disclosed by the observations.

The difference between the two regions is that in the lower region, the troposphere, the isothermal surfaces may be roughly described as horizontal, and in the stratosphere as vertical. The sudden transition from the horizontal sheet to the vertical sheet is the astounding feature which is exhibited at the tropopause all over the world; and as in the region of vertical isothermal surfaces the horizontal temperature gradient is from the equator towards the pole, and therefore opposite to that of the region where the isothermal surfaces are nearly horizontal, the opportunity of drawing effective attention to the paradoxical result of the equatorial region providing the coldest place on earth ought not to be missed. There is at least as much difference of temperature in the stratosphere between the equatorial region and the pole in one direction as there is at the surface in the opposite direction, at any rate in the summer, and if the upper region can be legitimately called isothermal, why not the surface layer?

It is remarkable that the chapters on the upper air draw their information from observations of the air of Europe. Our atmosphere has indeed been worn rather threadbare. We have drawn a number of conclusions from the European observations. They are largely confirmed by observations in Canada, and we are particularly anxious to know whether they are confirmed or contradicted by observations in the United States. So far as information has reached us, it would appear that the results for the United States show rather high temperatures and high pressures when brought into comparison with the observations of the rest of the world. That would indicate a sort of dislocation of the equatorial or tropical high pressure to the northward over the southern United States, at least in the summer. And as such a dislocation had already been indicated, years before the recent investigation of the upper air, by Teisserenc de Bort in his computed map of isobars at 4000 metres (which agrees in an extraordinary manner with the results of modern observations), we are naturally very curious to have compendious summaries of all the results for the United States, and to know whether the generalisations which we have made apply to them.

This brings to mind a certain shyness about tackling unsolved problems which other people have recognised as fundamental but have failed to solve. This shyness is a little bit characteristic of Prof. Humphreys's work, and is a rather disappointing feature of the book. One forms the idea of a workman with a bag of nice, sharp physical and mathematical tools who undertakes with unerring success, any job that can be done with the available implements, and who prefers to pass by, with some irreproachable but vaguely general remarks, a number of old problems which Maury, Redfield, Espy, Loomis, Ferrel, and, later, Bigelow tried to solve. This is the more to be regretted because Prof. Humphreys's work is really original; it is not compilation. We get the impression that, while possessed of almost unexampled facility for dealing with it, he has preferred to pass by on the other side when anything controversial came within sight and there was a chance of a row. As an example, optics, which is an amenable subject, gets a whole part, while sound, which is also physics, but not amenable, receives only a casual reference, and in the chapter on the atmospheric circulation, on the question of what actually steers the wind, a good deal of space is given to discussion of the deflection due to the earth's rotation and change of velocity with latitude, which is true enough in the vague sense that it supposes the air to be free to find its path "under no forces," or without constraint. We should prefer to start with the fact that in actual practice wind is never free from the constraint of the distribution of pressure. Some meteorologists still require to realise that if it were not for a certain suitable constraint a train that started due north from New Orleans would presently find itself running into the Atlantic Ocean at a speed of a hundred or two hundred miles an hour. Nobody really expects it to behave in that way; the flange sees that it does not: no more does the wind; pressure takes care that it does not. Hence the introduction of unconstrained motion on the earth's surface requires an apologia that is seldom forthcoming.

We should like to pass on to Prof. Humphreys the remark of a London street arab who found us on one occasion hurrying to a cab to reach some function that insisted upon an academic robe which we were concealing so far as anything scarlet can be concealed: "Put it on, sir; don't be shy." We share the feeling and appreciate the dilemma, but we feel sure that if Prof. Humphreys were less afraid of saying something that his academic colleagues might criticise, he could render great service to the difficult science of meteorology, even if the critics were correct. Although ultimately the physics of the air is the same as that in the laboratory, the physical problems of the atmosphere require special intellectual tools for their solution, and the use of new tools requires courage. One can, of course, keep out of range of reproach for unorthodoxy or misconception when treating the questions that really move the meteorological world, but it is not so helpful as the bolder course. What we should like to know is almost as important to a subject as what we do know beyond dispute.

It is only when we reach part iv.—"Factors of Climatic Control"—that the author becomes really argumentative, and thereby most interesting, in suggesting and endeavouring to demonstrate that dust projected into the stratosphere by volcanoes is the efficient cause of prolonged changes of temperature that express themselves in climatic changes, after examining and rejecting all the other explanations which have been proposed. On reaching those chapters we feel once more in the fresh, free air, and the solicitude for the academic robe is disregarded. The oppression of the four walls of the laboratory vanishes. There is a sense of relief when the author boldly calculates the rates of fall of dust under Stokes's law without taking account of the counteracting influence of eddy motion which is so potent throughout the atmosphere in keeping solid and liquid particles in suspension. It would tax our space too much to consider why the stratosphere in particular should have to carry this additional burden, but the whole subject is full of interest, and now that he has taken off the academic gloves and faced so controversial a question as the cause of the Ice-age we look to Prof. Humphreys to let us have his views about various problems of the circulation of the atmosphere in general, and of cyclonic circulations in particular, to which in the past the meteorologists of the United States have made some notable contributions which might now be reviewed and perhaps revised. Meanwhile he deserves our hearty thanks for a very useful and handy book of reference indispensable for the meteorological library.

NAPIER SHAW.

New American Text-books of Botany.

(1) *General Botany for Universities and Colleges.* By Prof. Hiram D. Densmore. Pp. xii + 459. (Boston and London: Ginn and Co., 1920.) 12*s*. 6*d*. net.

(2) *Laboratory and Field Exercises for "General Botany."* By Prof. Hiram D. Densmore. Pp. viii + 199. (Boston and London: Ginn and Co., 1920.) 3*s*. 9*d*. net.

(1) PROF. DENSMORE'S avowed intention is to "furnish both student and instructor with a helpful and connected statement of the more important facts and principles of modern botany." It is but rarely that an elementary text-book meets the requirements of teacher and student in equal degree; in striving after this ideal, Prof. Densmore has, one fears, fallen between two stools. For the student the statement is not sufficiently connected, and the teacher of university grade should not require help in regard to such elementary matter as fills the bulk of this book.

The discontinuous character of the text is aggravated by a noticeable lack of balance. Thus while the structure of stems, leaves, and roots is disposed of in thirty-three pages, an equal amount of space is devoted to an account of plant-breeding and evolution, which, moreover, deals principally with such modern developments as Mendelism and the mutation theory, touching but lightly on the more general aspects of evolution. The discussion of floral construction is inadequate, and the same remark applies to the chapter on fungi, which, in addition, is badly arranged, and gives no clue to the phylogeny of that group, the "simple classification" on p. 243 being in reality no classification at all. The author's didactic methods are often peculiar. Growth-movements are fully discussed before any account has been given of growth itself. The complex woody stem is described before the simpler herbaceous type. Part iii. ("Representative Families and Species of the Spring Flora") would fit better into a book of Nature-study than it does into the present volume, where its usefulness is not apparent. It is only fair to note that some of the foregoing criticisms are repelled in advance in the author's preface, where he professes his adherence to a "biological, economic, and ecological point of view" in preference to a taxonomic or phylogenetic outlook.

Opinions differ widely as to the best form of elementary botanical course, but most teachers will agree that it is better to concentrate even unduly on one aspect of the science—say, phylogeny, physiology, or even taxonomy—than to adopt the kaleidoscopic method favoured by Prof. Densmore, whose hint as to the lack of interest shown by beginning students in most aspects of botany (the fortunate exception being "cellular biology") is significant. It is claimed that the sections dealing with structure follow the teachings of the "newer anatomy"; in the absence of a precise definition, one is left in doubt as to how far this claim is justified, but the reviewer has searched in vain for any important anatomical facts or theories which have not figured in our elementary text-books for many years past. No mention whatever is made of palæobotanical evidence, which one would naturally expect to have an important bearing on the "newer anatomy."

There are a number of obvious inaccuracies